(12) UK Patent Application (19) GB (11) 2 142 502 A

(43) Application published 16 Jan 1985

(21) Application No 8416796

(22) Date of filing 2 Jul 1984

(30) Priority data

(31) 3323946 (32) 2 Jul 1983 (33) DE

(71) Applicant
Messerschmitt-Bolkow-Blohm GmbH (FR Germany),
Hunefeldstrasse 1-5, D 2800 Bremen 1, Federal Republic of Germany

(72) Inventors
Dieter Dey,
Peter Dunker,
Willi Hornfeld

(74) Agent and/or Address for Service
J. F. Williams & Co.,
34 Tavistock Street, London WC2E 7PB

(51) INT CL[3]
H04N 5/76 5/14 7/18

(52) Domestic classification
H4F D12M D12X D22 D27R9 D27T1 D27V D2A D30K D40P D83B DX
H4T 4R BRC
U1S 2302 H4F H4T

(56) Documents cited
GB A 2120495
GB A 2115659
GB A 2047042
GB 1535581
EP A2 0077107

(58) Field of search
H4F
H4T

(54) Device for producing large-picture assemblies

(57) A large-picture display, e.g. for vehicle (e.g. ship) simulation, is provided by recording new data from a pick-up sensor such as a static or rotating TV camera, e.g. with linear or areal mosaic CCD receptor, which views a model or real panorama. Picture processing removes overlap or fills gaps, leaving a modular set of fields, each e.g. 8·5° × 8·5°, recorded on video disc. In use the discs (50) are read out and digitized (51) to multi-bit RAMs (52) from which the data is read out for display (58), the whole system being under control of processor (59). Change of aspect is provided by varying the addressing of RAMs (52). A separate disc channel (50') is provided for moving objects, with priority according to nearness so that background and remote objects can be obscured. Selected multiple fields may be displayed on stacked picture screens, or by back projection.

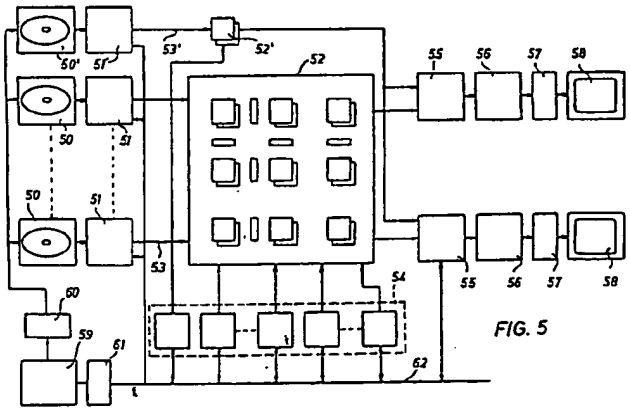
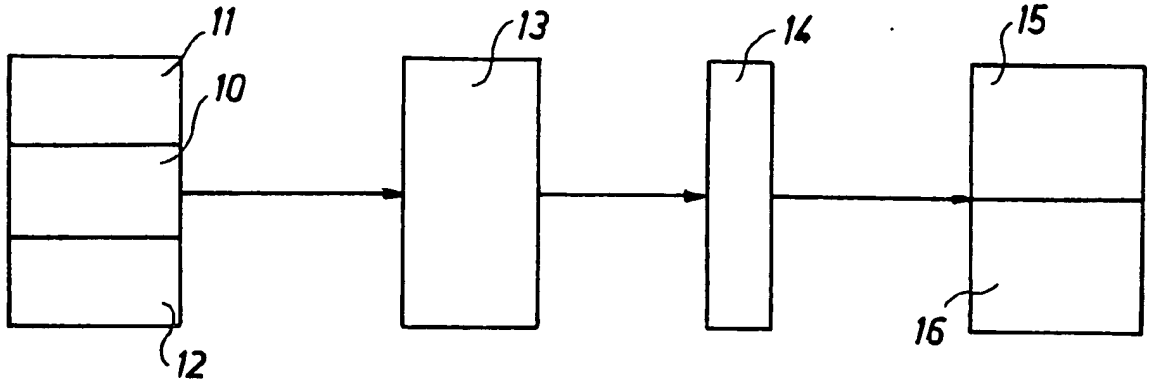


FIG. 5

GB 2 142 502 A

2142502

FIG. 1



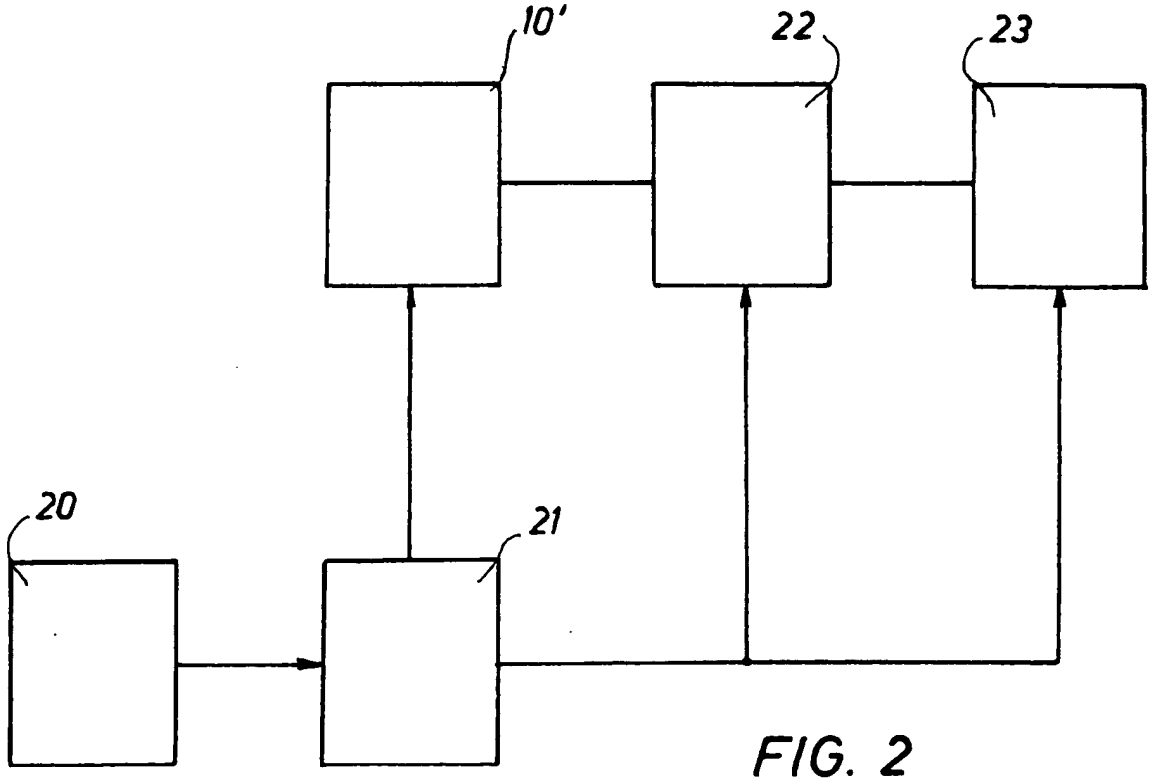


FIG. 2

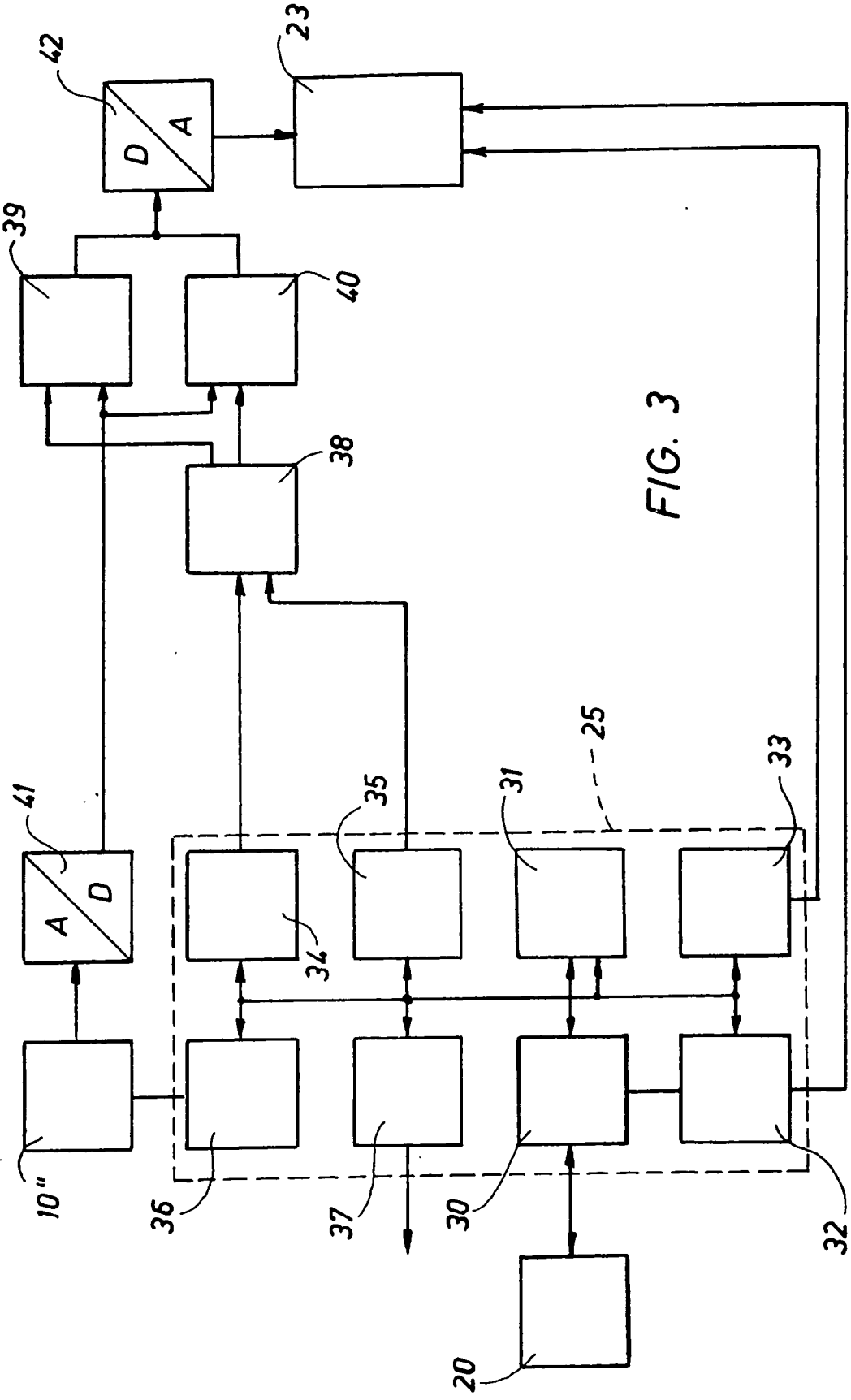


FIG. 3

2142582

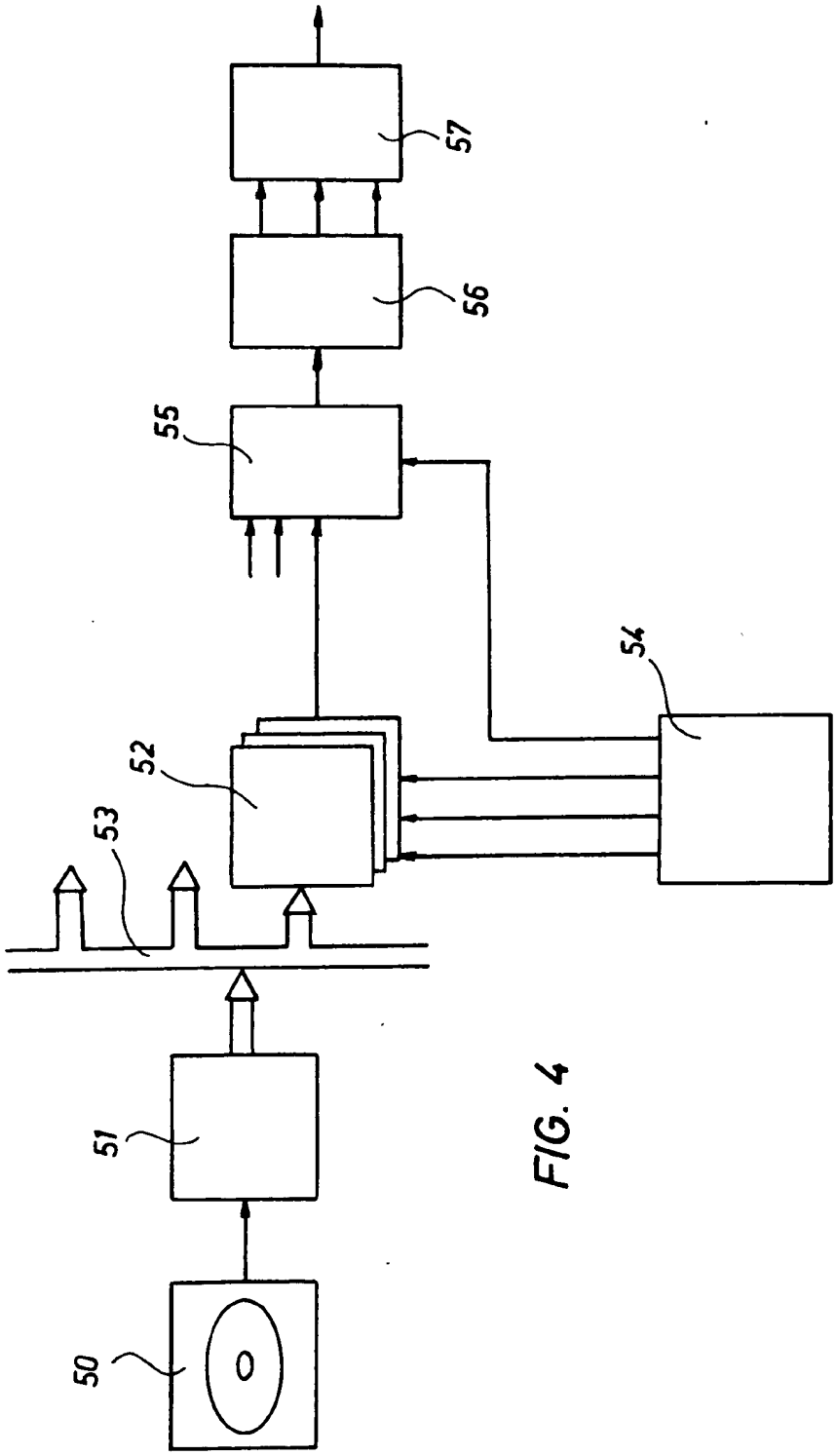


FIG. 4

2142592

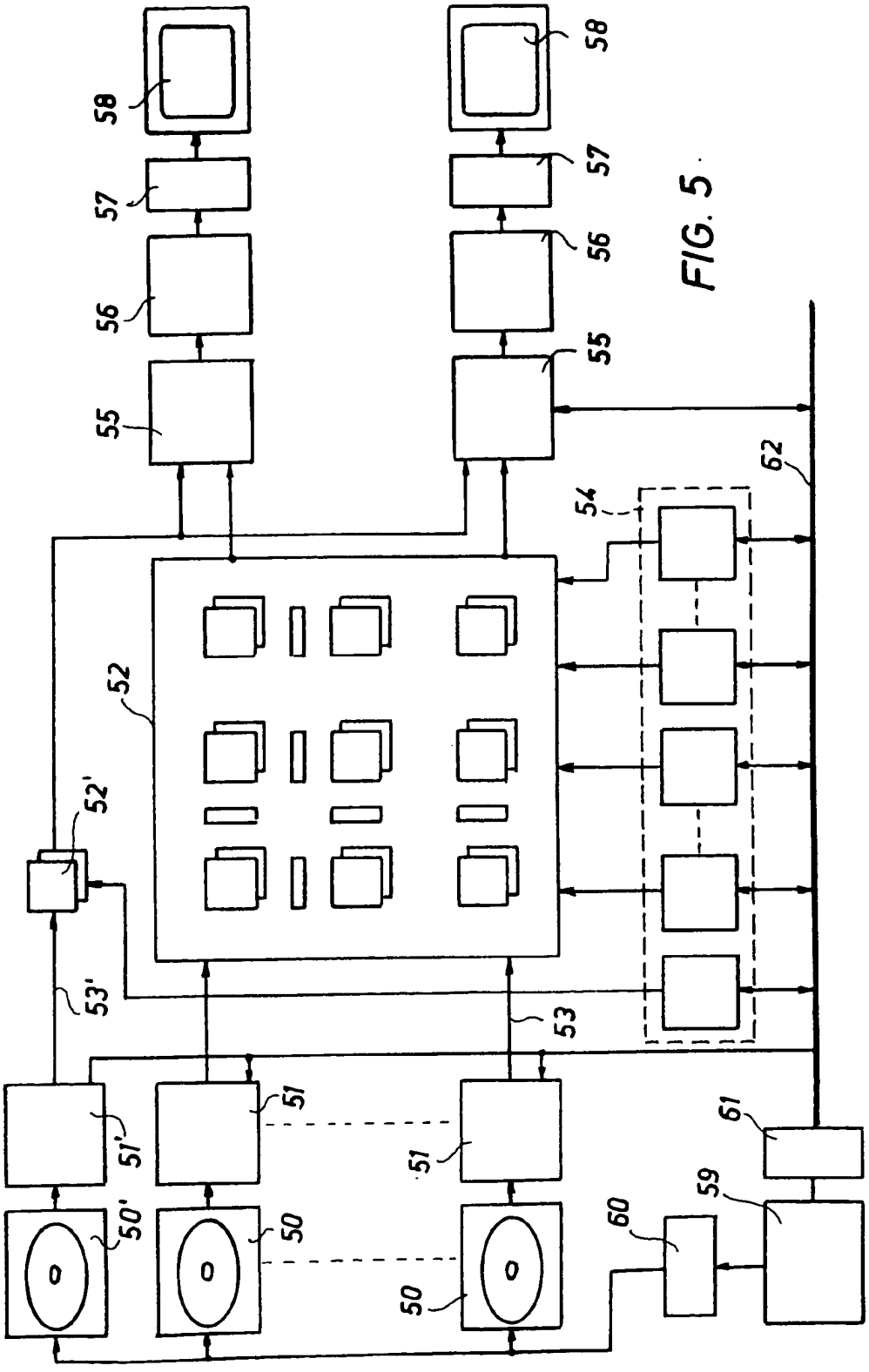


FIG. 5

SPECIFICATION

Device for producing large-picture systems

The invention relates to a device for producing large-picture systems such as simulated views for vehicle simulators and/or survey representations having an electronic picture pick-up sensor, the picture output data of which control picture reproduction equipment via stores and data processing stages.

Large-picture systems such as survey representations or simulated views have been used for a considerable time in various fields of technology. Preferred applications exist, for example, in vehicle simulators such as ship simulators in order to simulate a panoramic view there, or in observatories or strategic survey representations.

Hitherto, in vehicle simulators for example, it was usual to simulate the view with projection devices and for this purpose to take the films from models or naturally. In observatories or strategic survey representations, on the other hand, electromechanical view systems were used. These visual systems are regarded as out of date because of the weaknesses of their systems and therefore electronic large-picture systems, namely so-called CGI systems have already been proposed for such large-picture systems. Such CGI systems (CGI = computer generated images) produce areal pictures by producing the visual objects from a plurality of small areas which can be controlled electronically. Such a production of large pictures therefore requires a very large number of edges which bound the particular areas as a result of which the expenditure on circuitry and the expenditure on program control increase enormously. Coping with such amounts of data therefore involves such large problems that producing a picture with up to about 10000 edges is still regarded as logical. Such a number of edges is inadequate, however, for large-picture systems.

The invention seeks to provide a device for producing large-picture systems such as of the type mentioned at the beginning, which can produce visual systems by electronic means with manageable expense and manageable amounts of data.

According to the invention, there is provided a device for producing large-picture systems having an electronic picture pick-up sensor, the picture output data of which control picture reproduction equipment via stores and data processing stages, wherein the picture data of the pick-up sensor are digitalized and arrive, as raw data, via stores, at a picture processing installation for interactive picture preparation, and wherein the prepared picture data are converted into master data and supplied to video disc stores and can be called up from there for the reproduction.

As a result of the use of video disc stores, the measures according to the invention render possible the production of large-picture systems with manageable expense, wherein television projectors produce a computer-manipulated view with modular extensibility. The picking up of the picture data can be effected with a video camera, either with a rotating camera optical system for picking up panoramic picture data or with a rigid optical system for picking up picture data depending on direction, for example for survey representations. A linear or areal mosaic converter may be provided in the pick-up sensor both with a rotating and with a rigid optical system, for the production of electronic picture data.

In addition, the picture data of certain picture areas can be controlled in the picture data processing installation, by instructions which can be fed in for the correction of overlapping of adjacent picture areas as well as for the elimination and/or insertion of certain picture areas. As a result, it is possible, apart from the edge accounting (suppression of overlapping), also to delete certain picture regions and if necessary to insert certain other picture areas instead in the large picture produced.

The invention will now be described in greater detail by way of example, with reference to the drawings, in which:-

Figure 1 shows a general representation of a device in accordance with the invention from picture-data pick-up to picture reproduction;

Figure 2 shows a block circuit diagram of pick-up and storage of picture data with a TV camera;

Figure 3 shows a block circuit diagram of pick-up and storage of picture data with a linear mosaic converter;

Figure 4 shows a block circuit diagram to illustrate the data flow during the picture reproduction; and

Figure 5 shows a block circuit diagram of the circuit construction for the picture representation.

As the general representation of Figure 1 shows, the whole device comprises basically three operational groups, namely a picture pick-up, a picture-data processing installation, a data conversion and a picture reproduction. The picture pick-up consists of a pick-up sensor 10 which picks up that particular picture data from a model 11 or naturally. The output data of the pick-up sensor 10 are digitalized in an analogue-digital converter 12 and stored as raw data, for example on magnetic tapes, for further processing later. During "on-line" operation or further processing later, these raw data are supplied to a picture processing installation 13. After the picture processing installation 13, in which picture overlapping is accounted for as will be explained later, and picture areas can be eliminated or inserted, the picture data, after storage, arrive as master data at a converter stage 14 after which they are available for further use on video disc stores. Then the data of the video disc stores are prepared for the picture reproduction in picture producer stages 15 and reproduced on reproduction equipment 16.

Thus picture data can be picked up with the pick-up sensor 10, in "on-line" operation or in "off-line" operation, from models or in nature and so dynamic outside view representations, for example, can be produced for ship simulators. The necessary horizontal and vertical viewing angles are built up by modules with about 8.5° × 8.5° with a minimum resolution of one-sixtieth of one angular degree (1'). Larger viewing angles result from connecting up the modules. Dynamic outside views (panoramic views) of ship simulators are therefore produced as con-

nected up instantaneous photographs with a roatating camera optical system. For the vertical angle of representation 3 × 8.5° ~ 25°, may be provided as a viewing angle because as a general rule only the central region of the picture requires a high resolution for the visual representation. The lower and the upper edge of the picture normally only show water and sky.

The picture data picked up by the pick-up sensor, for example a television camera, are stored as raw data and during the later further processing in the picture-data processing installation are combined to produce a continuous panoramic view by singling out pictures which fit one another. Should the geometric distortions be too great during the pick-up with a conventional television camera or should the sensitivity be too low, then so-called "CCD real arrays or linear arrays" may be used instead. These are understood to include pick-up sensors with areal or linear mosaic converters. These pick-up sensors need a formatization of the picture information according to the CCIR standard, however, in order to be able to process the picture material appropriately. Linear arrays, however, require a high constancy for the speed of rotation of the camera optical systems during the picture taking.

When the invention is used to produce survey representations the picture data are produced by static picking up from photographs, objects, models or by graphic software which can be bought.

As can be seen from the block circuit diagram of Figure 2, the picking up of the picture data with a pick-up sensor 10 constructed in the form of a television camera 10' is controlled by a pick-up computer 20 via an interface 21. The picture data of the television camera 10' which are produced then pass via a video disc store 22 to a recorder 23. Both the recorder 23 and the video disc store 22 are synchronized by the pick-up computer 20 via the interface 21. The picture data recorded in the recorder 23 are then available as raw data for further processing in the picture-data processing installation 13.

If a CCD line sensor 10" is used as shown in Figure 3 to pick up the picture data, then the control of this pick-up sensor 10 is carried out by the pick-up computer 20 via a control device 25. This control device 25 is coupled to the pick-up computer 30 via an interface 20 which in turn is in mutual operational communication with a system control stage 31. Furthermore, a data formatizing stage 32, a recorder control stage 33, a write control stage 34, a read control stage 35, a timing control stage 36 and a deflection control stage 37 are in mutual operational communication with this system control stage 31. The timing control stage 36 controls the CCD sensor 10" directly, while the deflection control stage 37 acts on a mirror system preceding the CCD sensor 10". The write control stage 34 and the read control stage 35 control an address multiplexer 38 which addresses a store 39, 40 with each of its two outputs. These two stores 39, 40 working as a double store, are supplied with the picture data of the CCD sensor 10" conveyed via an analogue-digital converter 41 and they convey the incoming column scannings as data converted into the CCIR standard on to the recorder 23 via a digital-analogue converter 42. This measure is necessary because a normal television picture consists of two interlaced fields by the output signal of a CCD sensor delivers a continuous scanning. Apart from a picture pick-up turned through 90°, this would result in a wrong line coordination in the store. The recorder 23 is appropriately controlled by the data formatizing stage 32 and by the recorder control stage 33. The data for the format control may appropriately be recorded on the sound track of a magnetic tape provided to receive the picture data.

Thus the picture data picked up either with a television camera 10' or a CCD sensor 10" are available or further processing in the form of raw data stored on magnetic tape. There is now the possibility of preparing these picture data in the picture processing installation 13 to produce special simulated views. Thus it is possible to correct distortion which has occurred during the pick-up as well as overlapping of adjacent picture areas or to eliminate or insert certain picture areas. For this purpose the data are fed into and prepared in the picture processing installation consisting of stores, picture representation equipment and control stages, in the form of picture areas each of 8.5°. The desired preparation measures can then be carried out with a light pencil or with a computer. Thus objects, for example, which are to be eliminated from a picture, can be removed and the picture completed by adjacent image patterns. This possibility is particularly important for the processing of outdoor photographs because certain unwanted picture areas can be removed by this means. In addition, islands can be inserted or outlined with a light pencil or computer and be provided with distance information. This information is important for a later visual range calculation. The picture processing installation further offers the possibility of including data of specific objects from a data library in the picture data and so assembling certain outside views for ship simulators, which can be done by manual control or with the aid of a computer. The picture data thus produced are available as master data for the production of video discs for video disc stores. The picture-data processing installation is known in principle and is therefore only described as regards operation without more detailed representation.

The reproduction of the picture data, previously picked up and prepared, for the production of simulated views for vehicle simulators or survey representations can be effected in accordance with the block circuit diagram of Figure 4 which shows the basic data flow. Belonging to each 8.5° picture frame (picture module) is a video-disc reproduction unit controlled by a processor (visual computer). Visual representations with a viewing angle of more than 8.5° are composed of a plurality of picture frames. One video disc of a video-disc store can store the data of about 54000 television pictures and these data can be addressed individually and so located. Searching through a video disc can take up to 23 seconds and therefore it is possible to skip over a plurality of pictures within 40 msec. In the block

circuit diagram of Figure 4, the picture data of a video-disc store 50 are applied, via an analogue-digital converter 51, to a picture store 52 with a depth of 8-12 bits. The conveying of the digital picture data from the digital output of the analogue-digital converter 51 is effected by a real-time data bus 53 which can supply further picture stores. A stage 54 for controlling the method of operation, which is normally part of a processor illustrated in Figure 5, and which is represented as a block, serves for the control. The stage for controlling the method of operation simultaneously controls a read control stage 55 which reads the data out of the picture store 52 (bit-parallel, word serial) and delivers them via a picture-frame control stage 56 to a digital-analogue converter 57 for conveying on to a reproduction device. The representation of the individual pictures can be effected either by stacking picture screens with collimator lenses, by a lens image formation on a back projection screen or with a television projector and a back projecting screen. A back projection screen has the advantage that spot projectors with great brightness dynamics can be used to fade in extraneous objects. In addition, with a back projection screen, a gradual increase in view can be achieved, as at daybreak, beginning with outlines, that is to say pictures with little colour dynamics and low information density.

The reading out of the picture data from the picture stores and the further conveying to reproduction equipment is effected by means of the read control stage 55 and an address manipulation via the stage 54 for controlling the method of operation. All the picture stores 52 form a store structure out of which each reproduction device can read data. Horizontal and vertical image displacements are caused by an address computation. The number of picture stores 52 depends on the extent of the view to be represented, for example 240° or 360° of a vehicle simulator. Vertical image displacements can then be additionally effected if the picture storage range is greater than the picture representation range. In a simple version, this can be effected by repeating the picture information of the marginal region. Moving objects, which are additionally faded into the view to be represented should have their own information path with an additional video-disc store 50', an analogue-digital converter 51' and a picture store 52'. This can be seen from the block circuit diagram of Figure 5 which consists of the parallel information paths of Figure 4 including the information path for the above-mentioned moving objects. The data are called up from the picture store 52' by the read control stage 55 and switched to the particular monitor 58 via the picture-frame control stage 56 and digital-analogue converter 57. The position of the appearance of the moving object is defined by an address computation and the data of the object or objects are taken from the store instead of the background informaton by a priority evaluation. It is possible mutually to obscure up to three objects, for example to allow a ship to disappear behind an island. The individual information paths are controlled by a processor 59 which acts on all the video-disc stores 50 via an interface 60. This processor acts on the stage 54 for controlling the method of operation, the picture store 52 and the read control stages 55 via a further interface 61 and a system bus 62. This stage for controlling the method of operation here consists of a plurality of individual stages such as stages for the store management (SPV) and stages for the writing control (SS).

The construction of the picture stores 52 permits simultaneous reading and writing and image couplers are provided between the store blocks and permit a read-out of picture information which can be positioned as desired through the addressing. Picture store operations are controlled by the processor 59 via the system bus 62. If the system bus is overloaded by the operations, there is the possibility of connecting microprocessors to it and so controlling the picture stores 52. The read control is also performed via the system bus 62. This read control has four inputs (see Figure 4) so that four picture sources can be mixed with priority. The store management ensures a cyclic read-out of picture data at a timing rate of 50 Hz.

In the case of vehicle simulators it is advisable to keep the number of necessary pick-up points/source pictures as small as possible in order that the visual information of as large an operation area as possible can be stored. In order to achieve this, it is logical to distort the picture represented so that it can be adapted to the following picture with the fewest possible steps. The particular movement of an individual point in the picture depends on the speed of the vehicle, on the angle between direction of movement and direction of view and on the distance of the point in the picture. It is therefore necessary to take these picture distortions into consideration during picture representation, which can be done in a logical manner by inserting and/or omitting columns of picture dots by means of address manipulation during the read-out of the picture data from the picture store.

CLAIMS

1. A device for producing large-picture systems having an electronic picture pick-up sensor, the picture output data of which control picture reproduction equipment via stores and data processing stages, wherein the picture data of the pick-up sensor are digitalized and arrive, as raw data, via stores at a picture processing installation for interactive picture preparation, wherein the prepared picture data are converted into master data and supplied to video disc stores and can be called up from there for the reproduction.

2. A device as claimed in claim 1, wherein the pick-up sensor is constructed in the form of a video camera with a rotating camera optical system for picking up panoramic picture data.

3. A device as claimed in claim 1, wherein the pick-up sensor comprises a rotating camera optical system with an areal mosaic converted for picking up panoramic picture data.

4. A device as claimed in claim 1, wherein the pick-up sensor comprises a rotating camera optical system with a linear mosaic converted for picking up

panoramic data.

5. A device as claimed in claim 1, wherein an alignable video camera is used as the pick-up sensor, for picking up picture data depending on direction.

6. A device as claimed in any one of Claims 1 to 5, wherein the picture data of certain picture areas can be controlled by instructions which can be fed into the picture data processing installation to correct the overlapping of adjacent picture areas as well as to eliminate and/or insert certain picture areas.

7. A device as claimed in any one of Claims 1 to 6, wherein the picture output data of the video camera are supplied to a recorder via a video disc store, used as a buffer store, and a picture pick-up computer synchronizes the video camera, the video disc store and the recorded via an interface.

8. A device as claimed in claim 4 or claim 6 or 7 when appendent thereto, wherein the picture output data of the pick-up sensor provided with a linear mosaic converter are supplied, via an analogue-digital converter, to a double store controlled by an address multiplexer and pass from this, via a digital-analogue converter to a recorder, the record, the address multiplexer and the pick-up sensor being controllable by a control device in mutual operational communication with a pick-up computer.

9. A device as claimed in claim 8, wherein the control device comprises an interface which is in mutual operational communication with the pick-up computer and the interface which in turn is in mutual operational communication with a system control stage, controls a data formatizing stage which is coupled to a recorder control stage and controls the recorder jointly with this stage.

10. A device as claimed in claim 9, wherein the data formatizing stage and the recorder control stage are in mutual operational communication with the system control stage, a write control stage controlling the address multiplexer, and a read control stage and two control stages controlling the timing or the deflection of the pick-up sensor.

11. A device as claimed in Claim 7, or any claim appendant directly or indirectly thereto, wherein the picture data of the recorder are impressed, as master data, on video disc stores.

12. A device as claimed in any one of Claim 1 to 11, wherein the picture data of the video disc stores pass, via a digitalizing stage and a real-time data bus to a plurality of parallel picture stores and the picture store, which can be controlled by an operation control stage for controlling the method of operation, supplies the picture data, via a read control stage which can likewise be controlled by the operation control stage for controlling the method of operation, a picture-frame control stage and a digital-analogue converted to a monitor for reproduction.

13. A device as claimed in any one of claims 1 to 12, wherein a plurality of video disc stores which can be controlled by a processor via an interface, supply their picture data, via digitalizers and a real-time bus, to a picture store, and the processor controls control stages for store management and writing control of the picture store as well as read-out control stages via a further interface and a data bus.

14. A device as claimed in any one of the claims 1 to 13, wherein a further video disc store is provided which can be controlled by the processor via the associated interface and the picture data of which pass to a separate picture store which can be controlled by a separate stage for store management and can be called up by the read-out control stages for the picture reproduction.

15. A device for producing large picture systems, substantially as described herein with reference to the drawings.

Printed in the UK for HMSO, D8818935, 11/84, 7102.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.